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[Title of the Invention] ULTRASONIC INSPECTION SYSTEM HAVING A ULTRASONIC PROBE DATA MANAGEMENT FUNCTION

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[Title of the Invention] ULTRASONIC INSPECTION SYSTEM HAVING A ULTRASONIC PROBE DATA MANAGEMENT FUNCTION

[Claims]

[Claim 1] A ultrasonic inspection system having a ultrasonic probe data management function for transmitting and receiving ultrasonics with one of ultrasonic probes and inspecting a specimen based on a received ultrasonic signal, the ultrasonic inspection system comprising an external storage medium for storing general characteristic data of each of the ultrasonic probes.

[Claim 2] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 1, wherein the general characteristic data of each ultrasonic probe stored on said external storage medium is data at manufacturing time of the ultrasonic probe and data added to the data or updated data each time the ultrasonic probe is inspected.

[Claim 3] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 1 or 2, the ultrasonic inspection system comprising:

ultrasonic probe inspection means for executing inspection for getting predetermined characteristic data of the ultrasonic probe; and

characteristic data storage means for storing the characteristic data provided by said ultrasonic probe inspection

means on said external storage medium.

[Claim 4] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 1 or 3, the ultrasonic inspection system comprising a storage section for storing data stored on said external storage medium.

[Claim 5] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in any one of claims 1 to 4, the ultrasonic inspection system comprising a display section for displaying the data stored on said external storage medium or said storage section.

[Claim 6] A ultrasonic inspection system having a ultrasonic probe data management function for transmitting and receiving ultrasonics with one selected from ultrasonic probes and inspecting a specimen based on a received ultrasonic signal, wherein each of said ultrasonic probes is provided with a storage device for storing general characteristic data of said ultrasonic probe.

[Claim 7] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 6 wherein the general characteristic data of said ultrasonic probe stored in said storage device is data at manufacturing time of said ultrasonic probe and data added to the data or updated data each time said ultrasonic probe is inspected.

[Claim 8] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 6 or 7, the ultrasonic inspection system comprising:

ultrasonic probe inspection means for executing inspection for getting predetermined characteristic data of said ultrasonic probe; and

characteristic data read means for storing the characteristic data provided by said ultrasonic probe inspection means in said storage device.

[Claim 9] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 6 or 8 comprising a storage section for storing the data stored in said storage device.

[Claim 10] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in any of claims 6 to 9 comprising a display section for displaying the data stored in said storage device.

[Claim 11] A ultrasonic inspection system having a ultrasonic probe data management function for transmitting and receiving ultrasonics with one selected from ultrasonic probes and inspecting a specimen based on a received ultrasonic signal, said ultrasonic inspection system comprising:

a computer connected to one or more ultrasonic inspection systems by a transmission line;

probe data collection means for collecting characteristic data of the ultrasonic probes contained in said computer; and

a storage section for storing the characteristic data collected by said probe data collection means.

[Claim 12] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 11, wherein said computer comprises:

ultrasonic probe inspection means for re-inspecting the ultrasonic probe connected by the transmission line; and

characteristic data read means for storing the characteristic data provided by said ultrasonic probe inspection means in said storage section via the transmission line.

[Claim 13] The ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 11 or 12 further including a display section for displaying the data stored in said storage section.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

This invention relates to a ultrasonic inspection apparatus for transmitting and receiving a ultrasonic wave by a ultrasonic probe, and inspecting a specimen based on the received ultrasonic, and further relates to a ultrasonic inspection apparatus having a data management function of a ultrasonic probe which has a function to manage characteristic data of the ultrasonic wave probe.

[0002]

Non-destructive inspection systems using ultrasonic (ultrasonic inspection systems) are used in various fields of inspection of steel, metal, etc., to inspection of

semiconductors in recent years. They are used in various departments as field inline inspection tools to research and development tools. They have various shapes of handy type portable by the inspector to installation type installed in the field. A representative system configuration is shown in FIG. 7.

[0003]

FIG. 7 is a block diagram of a ultrasonic inspection system. A ultrasonic probe 1 (hereinafter referred to as a probe) is a sensor section for transmitting and receiving ultrasonics. A ultrasonic transmission/reception circuit 2 (simply, transmission/reception circuit) is a circuit for transmitting and receiving ultrasonics to and from the probe 1. Normally, the transmission/reception circuit 2 excites a piezoelectric vibrator in the probe 2 by a high-pressure impulse signal for generating (transmitting) ultrasonics and amplifies a minute signal received at the piezoelectric vibrator to a predetermined voltage signal level by an amplifier. A waveform processing circuit 3 is a processing section for displaying the inspection result based on a received waveform. For example, the waveform processing circuit 3 takes out a part of the waveform by a gate circuit, extracts the maximum value, and compares the value with a predetermined determination level, thereby determining the inspection result. It also displays the extracted maximum values as light and dark values in order at predetermined positions of a display section 4, thereby forming a ultrasonic image. A control section 5 controls

the transmission/reception circuit 2 and the waveform processing circuit 3. In recent years, a personal computer (PC) has often been used as the control section 5.

[0004]

A ultrasonic inspection system of installation type comprises a transporter for moving the system, a scanner for changing the position of a probe or a sample, and the like in addition to the above-described members. Although one probe is used in the description, two probes are used in an inspection method with separate probes for transmission and reception (2-probe method). For a large specimen used on a steel line, etc., the number of probes may range from several tens to several hundreds. In this case, generally the number of transmission/reception circuits is also increased in response to the number of probes. An array probe having an array of several ten to several hundred minute vibrators in one probe may be used.

[0005]

[Problem to be solved by the Invention]

The following three ultrasonic inspection methods are available: Direct contact method, water immersion method, and local water immersion method. The direct contact method is a method of bringing a probe and a specimen into direct contact with each other via a contact medium, such as glycerin or machine oil, for inspecting a specimen while changing the position of the probe on the specimen manually or automatically. At this time, the probe is rubbed against the specimen. The water

immersion method is a method of entering a specimen and a probe in a water tank and using water as a ultrasonic propagation medium therebetween. The local water immersion method is a method of immersing only the space between a specimen and a probe in water. In both the water immersion method and the local water immersion method, the probe is always in contact with water.

[0006]

Since the probe use environment is bad in either of the methods, the probe is often broken as it is used for a given term. To attach a probe to an automatic scanning mechanism, etc., for inspecting a specimen, an accident such that the probe collides with the specimen, etc., and is broken also often occurs. A vibrator for transmitting and receiving ultrasonics in a probe is made of a thin ceramic, etc., and thus is very vulnerable to mechanical vibration or shock. An accident also often occurs such that while a probe is being replaced or during manual inspection, the probe is dropped to the floor and is broken. Thus, the probes are handled as equivalents of consumables.

[0007]

Further, since probes are handmade, the product quality varies from one probe to another and if the probes are used under the same condition, some are not broken and some are easily broken; they are broken in various manners. If a vibrator is broken due to the above-mentioned collision accident, ultrasonic reception signals disappear entirely; if a vibrator

is broken gradually by exfoliation, etc., for example, as water enters, the ultrasonic reception signal level lowers gradually (degradation of characteristic as described above). In the former case, no signals are received, thus malfunction of the system is easily detected; in the latter case, an error in the probe is easily unrecognized for a certain term because of moderate change (difficulty to predict as described above).

[0008]

As mentioned above, the probe often breaks, and a new probe often has to be supplied. Since probes are handmade, the product quality varies from one probe to another. The probe has parameters such as a frequency, sensibility, focal length, etc., these parameters varies for each product. For example, even if probes each having a central frequency of 10MHz are ordered, actually delivered probes have various central frequencies in a range of 8 to 12 MHz. JIS Z2300 clearly distinguishes "a nominal frequency of indicated frequency on a probe" from "a test frequency used in a detection test". Normally, each probe has an inspection report table that shows a frequency characteristic graph, ultrasonic waveform, etc. However, probe's characteristics are deteriorated by use of the prove, and the probe shows different characteristics. The inspection report table of a paper is likely to be missed.

[0009]

On the other hand, it is preferable that a ultrasonic inspection for a specimen is precise as a matter of course. Accordingly, a prove has to be seleced for a ultrasonic inspection

after the true characteristics of the prove are known. However, in fact, the selection of the best suited proves is difficult based on the inspection report tables of all the possessed proves. The user sometimes selects and uses the possessed probes having parameters near inspection conditions. Specifically, it tends to be the above situation in case that the probe users are plural, and the number of apparatus is plural.

[0010]

It is an object of the invention to provide a ultrasonic inspection system having a data management function of a ultrasonic probe, to solve the problems in the related art, know the precise parameters of probes the user has, and perform a highly precise inspection.

[0011]

[Means for solving the problem]

To attain the above object, according to the invention as claimed in claim 1, there is provided a ultrasonic inspection system having a ultrasonic probe data management function for transmitting and receiving ultrasonics with one of ultrasonic probes and inspecting a specimen based on a received ultrasonic signal, the ultrasonic inspection system comprising an external storage medium for storing general characteristic data of each of the ultrasonic probes.

[0012]

According to the invention as claimed in claim 3, in the ultrasonic inspection system having a ultrasonic probe

data management function as claimed in claim 1 , the ultrasonic inspection system comprises:

ultrasonic probe inspection means for executing inspection for getting predetermined characteristic data of the ultrasonic probe; and

characteristic data storage means for storing the characteristic data provided by said ultrasonic probe inspection means on said external storage medium.

[0013]

According to the invention as claimed in claim 4, in the ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 1 or 3, the ultrasonic inspection system comprises a storage section for storing data stored on said external storage medium.

[0014]

According to the invention as claimed in claim 5, in the ultrasonic inspection system having a ultrasonic probe data management function as claimed in any one of claims 1 to 4, the ultrasonic inspection system comprises a display section for displaying the data stored on said external storage medium or said storage section. According to the invention as claimed in claim 1, there is provided a ultrasonic inspection system having a ultrasonic probe data management function for transmitting and receiving ultrasonics with one selected from ultrasonic probes and inspecting a specimen based on a received ultrasonic signal, wherein each of said ultrasonic probes is

provided with a storage device for storing general characteristic data of said ultrasonic probe.

[0015]

According to the invention as claimed in claim 8, in the ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 6, the ultrasonic inspection system comprises:

ultrasonic probe inspection means for executing inspection for getting predetermined characteristic data of said ultrasonic probe; and

characteristic data read means for storing the characteristic data provided by said ultrasonic probe inspection means in said storage device.

[0016]

According to the invention as claimed in claim 9, the ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 6 or 8 comprises a storage section for storing the data stored in said storage device.

[0017]

According to the invention as claimed in claim 10, the ultrasonic inspection system having a ultrasonic probe data management function as claimed in any of claims 6 to 9 comprises a display section for displaying the data stored in said storage device. According to the invention as claimed in claim 11, there is provided a ultrasonic inspection system

having a ultrasonic probe data management function for transmitting and receiving ultrasonics with one selected from ultrasonic probes and inspecting a specimen based on a received ultrasonic signal, said ultrasonic inspection system comprising:

a computer connected to one or more ultrasonic inspection systems by a transmission line;

probe data collection means for collecting characteristic data of the ultrasonic probes contained in said computer; and

a storage section for storing the characteristic data collected by said probe data collection means.

[0018]

According to the invention as claimed in claim 12, in the ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 11, said computer comprises:

ultrasonic probe inspection means for re-inspecting the ultrasonic probe connected by the transmission line; and

characteristic data read means for storing the characteristic data provided by said ultrasonic probe inspection means in said storage section via the transmission line.

[0019]

According to the invention as claimed in claim 13, the ultrasonic inspection system having a ultrasonic probe data management function as claimed in claim 11 or 12 further

comprises a display section for displaying the data stored in said storage section.

[0020]

[Embodiments of the invention]

The invention will be described with reference to embodiments with drawings. FIG. 1 is a block diagram of a ultrasonic inspection system having a data management function of a ultrasonic probe according to a first embodiment of the invention. Parts identical with or equivalent to those previously described with reference to FIG. 7 are denoted by the same reference numerals in FIG. 1 and will not be discussed again. The configuration of Fig. 1 is different from that of Fig. 7, in that a probe data storage section and a data storage medium are added. The data storage medium 7 is an external storage medium that can be written and read by a control section 5 and a floppy disk, a magneto-optic disk, an IC card (PC card), etc., can be used as the data storage medium. The data storage media 7 are provided in a one-to-one correspondence with probes. When a probe is shipped, the probe and the data storage medium 7 corresponding thereto are shipped in a pair. Normally, the model and the manufacture number are printed on the probe surface by inscription, etc., thus they are also described on the surface of the data storage medium 7 for relating the probe and the data storage medium 7 to each other.

[0021]

FIG. 2 is a table to show a data format example of the data storage medium, as previously described in the first

embodiment. That is, the data is stored in a spreadsheet format used with PC software. At the shipment time of each probe, the data is written into row A shown in FIG. 2 containing nominal value and actual measurement value columns. The nominal value column contains entries of vibrator diameter, center frequency, focal distance, etc., of the specifications required for ordering the probe including the model and the manufacture number.

[0022]

In the example shown in FIG. 6, beam diameter is entered in addition to the entries. For a probe of vertical focus type used with a water immersion method, the half-breadth beam diameter (theoretical value) is found as follows:

$$d = 0.71\ \lambda F/R$$

(d: Beam diameter, λ: Wavelength, F: Focal distance, R: Vibrator radius)

Since this value is used as reference to determine which probe is to be used with respect to the target defect size, the user should have the value as a reference value although data documents presented by the manufacturer scarcely describe the value.

[0023]

The actual measurement value column stores shipment inspection data and contains entries of center frequency, upper limit frequency, lower limit frequency, band width, focal

distance, sensitivity, electrostatic capacity, etc., including the date and the inspector. The pulse width and beam diameter used as resolution index of the probe are also described. After the probe shipment, the actual measurement value rows of the data increase each time the user or the manufacturer re-inspects the probe as required. The probe is re-inspected periodically or after specimen measurement, but the re-inspection time is not defined. In the example shown in FIG. 2, the user executes two inspections and the inspection results are written into rows B and C. In the inspection example, the probe is re-inspected for pulse width and sensitivity and it is understood from the digit change that the probe is damaged gradually. The entries of the nominal value and actual measurement value columns shown in FIG. 2 are applied to the probe of vertical focus type used with the water immersion method; they vary depending on the probe type. For example, for a bevel probe, a refraction angle entry is included; for an array probe, entries of the number of channels, channel-to-channel phase difference, etc., are included.

[0024]

Next, how to use the system shown in FIG. 1 will be discussed with reference to a display example shown in FIG. 3.

1. To register a new probe

The data storage medium 7 corresponding to the probe to be registered is set in a control section 5 and the probe

data written on the data storage medium 7 is transferred to the probe data storage section 6. If the data of another probe is written in the probe data storage section 6, the data of the new probe is added.

2. To select a probe for ultrasonic inspection

1) The data written in the probe data storage section 6 is displayed on a display section 4 as required. A display example is shown in FIG. 3, wherein rows D, E, and F show data of different probes and the data corresponding to row A shown in FIG. 2 is displayed.

The probe in row D shown in FIG. 3 (probe number 1) corresponds to the probe in row A shown in FIG. 2. As seen from "USER INSPECTION 2" in entry "MOST RECENT INSPECTION CONTENTS," two user inspections are executed and the most recent data is read and displayed for re-inspection items "PULSE WIDTH" and "SENSITIVITY." The data in rows E and F is inspection data at the shipment time and the probes in rows E and F are not re-inspected.

2) An optimum probe for the inspection to be executed is selected from among the probes involving the displayed data as shown in FIG. 3.

Since FIG. 3 is provided in the spreadsheet format, processing functions such as data retrieval and data sort can be used, enabling the user to easily select the optimum probe.

3. To re-inspect a probe

1) The probe to be re-inspected is connected to a system main body and the data storage medium 7 corresponding to the probe is set in the control section 5.

2) A probe inspection program of the control section 5 is operated.

3) The probe data updated by re-inspecting the probe is written into the probe data storage section 6 and the data storage medium 7. To write the probe data, the data before the probe is re-inspected may be replaced with the updated probe data or the old data may be recorded along with the updated probe data, as shown in FIG. 2.

[0026]

As an example of the re-inspection, the frequencies are re-inspected by emitting ultrasonics to a flat steel sheet, etc., used as the reference and obtaining a reflected wave or performing an empty shot and inputting an oscillation wave, then executing FFT (fast Fourier transform) analysis for providing the center, upper limit, and lower limit frequencies. The pulse width is re-inspected by converting an obtained analog waveform into digital form. The sensitivity is re-inspected by emitting ultrasonics to a reference object, obtaining its reflected wave, and finding a ratio between the pulse amplitude and the reflected wave amplitude.

[0027]

When they are re-inspected, the waveform subjected

to A/D conversion and the FFT result may be stored and managed as probe data and the probe data may be displayed as a graph on the display section 4 as required. FIG. 4(a) and FIG. 4(b) show waveform examples of the probe data. FIG. 4(a) is a chart to show the FFT result waveform, wherein frequency is entered on the horizontal axis and reflected wave strength is entered on the vertical axis. FIG. 4(b) is a chart to show the waveform of the reflected wave, wherein time is entered on the horizontal axis and voltage is entered on the vertical axis. Such waveforms are stored and managed as probe data and are displayed on the display section 4 as required.

[0028]

If two or more systems shown in FIG. 1 exist, the data of all probes is not necessarily stored in the probe data storage sections 6 of all systems. Therefore, as seen from the steps 1 to 3 described above, it is the data storage medium 7 that holds the most recent inspection data reliably. Therefore, it is desirable to always carry (manage) the probe and its corresponding data storage medium 7 in a pair. If only one system exists, the data of all probes is stored in the probe data storage section 6, thus the data storage medium 7 need not be used.

[0029]

In the embodiment, the data storage media for storing the characteristic data of probes are provided in a one-to-one correspondence with the probes and when a probe is re-inspected, it is automatically re-inspected according to the program

contained in the system, the inspection result is stored on the corresponding data storage medium, and the data stored on the data storage medium is stored in the probe data storage section and is displayed on the display section. Thus, the accurate specification values of the held probes can be easily obtained, so that a proper probe can be selected for executing highly accurate inspection. Probe failure, breakage, and replacement time are not overlooked owing to the probe re-inspection data. Resultantly, an inspection result error can be prevented. Further, since probes can also be re-inspected automatically, the load can be taken off the inspector.

[0030]

FIG. 5 is a block diagram of a ultrasonic inspection system comprising a ultrasonic probe data management function according to a second embodiment of the invention. Parts identical with or equivalent to those previously described with reference to FIG. 1 are denoted by the same reference numerals in FIG. 5 and will not be discussed again. The configuration shown in FIG. 5 differs from that shown in FIG. 1 in that a probe 10 contains a data storage device 70, which is connected to a control section 5. That is, the data storage medium 7 is used in the embodiment shown in FIG. 1, but the data storage device 70 is used in the fourth embodiment in place of the data storage medium 7.

[0031]

Since the probe contains the storage device for storing the characteristic data of the probe in the embodiment, the

same effect as that of the third embodiment is produced and the need for managing or carrying the data storage medium apart from the probe as in the third embodiment is eliminated; an easy-to-use system is provided and it is not feared that the data storage medium may be lost.

[0032]

FIG. 6 is a block diagram of a ultrasonic inspection system comprising a ultrasonic probe data management function according to a third embodiment of the invention. Parts identical with or equivalent to those previously described with reference to FIG. 1 are denoted by the same reference numerals in FIG. 6 and will not be discussed again. Numeral 50 denotes a host computer; 60, a probe data strage section connected to the host computer 50; 80, a network bus. In the embodiment, a network is formed by at least one ultrasonic inspection system is connected with the host computer 50 via the network bus 80. The figure shows a plurality of ultrasonic inspection system connected with the host computer, and a control section of one of the system is denoted as numeral 5'. In the network, for example, the host computer 50 and probe data strage section 60 is put at a producer or manager side.

[0033]

In the aforermentioned embodiments, the user (each ultrasonic inspection system) performs storage and management of the probe data. In this embodiment, the storage and management of the probe data is performed at the host computer 50. In this embodiment, data of a newly purchased probe is stored

in a probe data storage section 60 by a data storage medium 7. When each inspection system rechecks a probe, the data of the probe is stored via the network bus 80 and the host computer 50. Accordingly, the data storage medium 7 has no use for the system after the initial data is stored in the probe data storage section 60. In this case, although the data storage medium is read at the host computer 50, as well as shown in Fig. 1, it may be read at the control section 5. The producer, manager and user may be initially registers the data at the probe data storage section. In case of selection of probes for a ultrasonic inspection, each inspection system reads out data of each probe from the probe data storage section 60 via the network bus 80 and the host computer 50, and the data can be seen on the display section 4.

[0034]

Scale of the networks are large or small. The small scale network is LAN, and the large scale network is, for example, the Internet using telecommunication network, etc. The LAN is suitable for forming a network by ultrasonic inspection systems in a factory. The Internet is suitable for managing probes delivered worldwide by a producer of the probes. In this case, if the host computer 50 has software for rechecking the probes, the host computer 50 operates the software to automatically recheck the probes in response to request from the users, and provides a service of recording the results of the recheck in the probe data storage section 60 as histories.

[0035]

As mentioned above, according to this embodiment, since the network is formed by at least one ultrasonic inspection system and a host computer, the effect of the first embodiment is achieved, and all probes of the ultrasonic inspection systems are managed by the host computer, so as to considerably reduce the load applied to the user.

[0036]

[Effect of the Invention]

As described above, in the invention, the external storage media for storing the characteristic data of probes are provided in a one-to-one correspondence with the probes, thus the accurate specification values of the held probes can be easily obtained, so that a proper probe can be selected for executing highly accurate inspection. When a probe is re-inspected, it is re-inspected automatically according to the program contained in the system and the inspection result is stored on the data storage medium. Thus, the re-inspection load can be taken off the inspector, and probe failure, breakage, and replacement time are not overlooked owing to the probe re-inspection data. Resultantly, an inspection result error can be prevented. Further, since the probe contains the storage device for storing the characteristic data of the probe, the need for managing or carrying the data storage medium apart from the probe is eliminated; an easy-to-use system is provided and it is not feared that the data storage medium may be lost. Further, one or more ultrasonic inspection systems and the host computer make up the network, thus the host computer can

manage the probes of the ultrasonic inspection systems in a unified manner and the load can be drastically taken off the user.

[Brief description of the drawings]

[Fig. 1]

A block diagram of a ultrasonic inspection system comprising a ultrasonic probe data management function according to a first embodiment of the invention.

[Fig. 2]

A drawing showing an example of data form of a data storage medium.

[Fig. 3]

A table to show a probe data display example.

[Fig. 4]

Charts to show waveform examples of probe data.

[Fig. 5]

A block diagram of a ultrasonic inspection system comprising a ultrasonic probe data management function according to a second embodiment of the invention.

[Fig. 6]

A block diagram of a ultrasonic inspection system comprising a ultrasonic probe data management function according to a third embodiment of the invention.

[Fig. 7]

A block diagram of a conventional ultrasonic inspection system.

[Reference numerals]

1 Probe

2 Ultrasonic transmission and reception circuit

3 Waveform processing circuit

4 Display section

5 Control section

6 Probe data storage section

7 Data storage medium

[Document name] ABSTRACT

[Abstract]

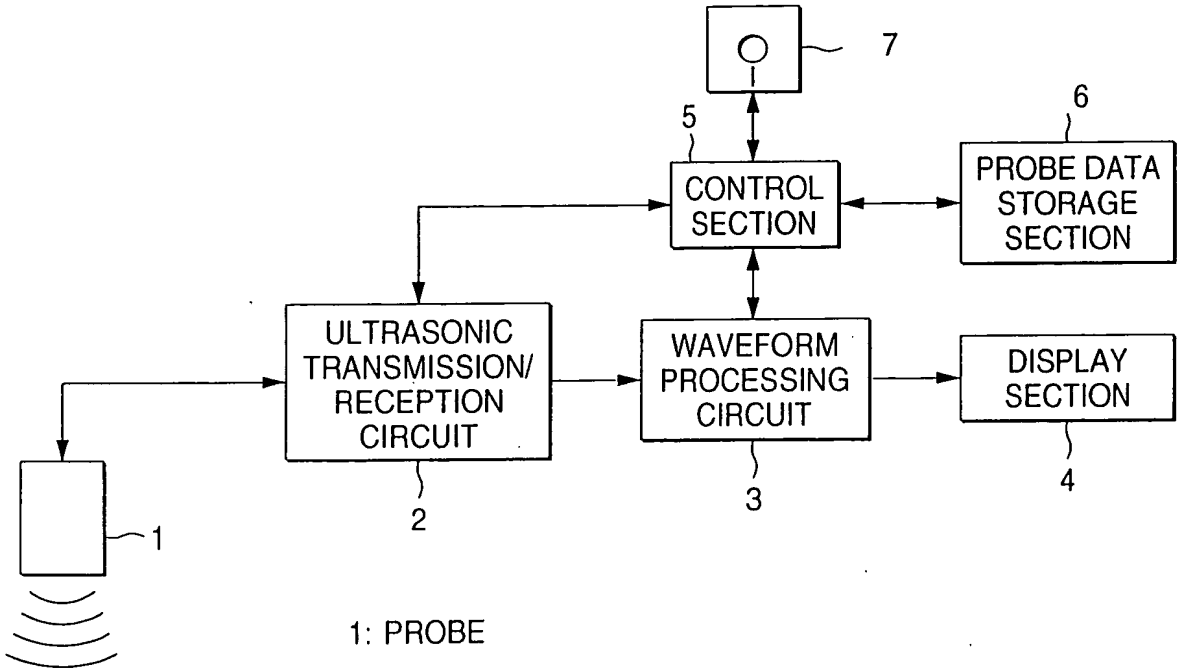
[Problem to be solved]

To provide a ultrasonic inspection system having a data management function of a ultrasonic probe, to know precise general parameters of probes the user has, and perform a highly precise inspection.

[Means]

A ultrasonic inspection system includes a probe 1, a ultrasonic transmission/reception circuit 2, a waveform processing circuit 3, a display section 4, a control section 5, and a probe data storage section 6. The probe includes a plurality of probes each having different characteristics, in which the best fitted probe is used for ultrasonic inspection. A data storage medium 7 corresponding to each probe is provided with each probe. The data storage medium 7 stores the characteristic data of the corresponding probe. The control section 5 reads out data stored in the data storage section 7 and stores them into a probe data storage section 6. The recheck of the probe is automatically performed according to the processing of the control section 5, and the results thereof are stored in the data storage medium 7 and the probe data storage section 6.

FIG. 1


7
6
5
CONTROL SECTION
PROBE DATA STORAGE SECTION
ULTRASONIC TRANSMISSION/ RECEPTION CIRCUIT
WAVEFORM PROCESSING CIRCUIT
DISPLAY SECTION
1
2
3
4

1: PROBE

FIG. 2

NOMINAL VALUES	MODEL	10Z20F15		
	MANUFACTURE NO.	KH010-25		
	VIBRATOR DIAMETER (mm)	20		
	CENTER FREQUENCY (MHz)	10		
	FOCAL DISTANCE (mm)	15		
	BEAM DIAMETER (mm)	0.16		
	⋮	⋮		
ACTUAL MEASURE-MENT VALUES	INSPECTION CONTENTS	SHIPMENT INSPECTION	PERIODIC INSPECTION 1	PERIODIC INSPECTION 2
	DATE	1996 / 8 / 5	1997 / 2 / 7	1997 / 3 / 1
	INSPECTOR	KENTA HITACHI	YOSHIHIKO TAKISHITA	YOSHIHIKO TAKISHITA
	CENTER FREQUENCY (MHz)	11.2		
	LOWER FREQUENCY (MHz)	7.5		
	HIGHER FREQUENCY (MHz)	13.4		
	BAND WIDTH (%)	52.7		
	FOCAL DISTANCE (mm)	15.3		
	PULSE WIDTH (μm)	0.35	0.42	0.51
	BEAM DIAMETER (mm)	0.18		
	SENSITIVITY (dB)	-34.8	-37.5	-41.2
	ELECTROSTATIC CAPACITY (pF)	210		
	⋮	⋮	⋮	⋮
		ROW A	ROW B	ROW C

FIG. 3

	PROBE REFERENCE NO.	1	2	3	-----
NOMINAL VALUES	MODEL	10Z20F15	10Z20F15	15Z10F10	
	MANUFACTURE NO.	KH010-25	KH010-23	KH015-13	
	VIBRATOR DIAMETER (mm)	20	20	10	
	CENTER FREQUENCY (MHz)	10	10	15	-----
	FOCAL DISTANCE (mm)	15	15	10	
	BEAM DIAMETER (mm)	0.16	0.16	0.14	
	⋮	⋮	⋮	⋮	
ACTUAL MEASURE-MENT VALUES	MOST RECENT INSPECTION CONTENTS	USER INSPECTION	SHIPMENT INSPECTION	SHIPMENT INSPECTION	
	MOST RECENT INSPECTION DATE	1997 / 3 / 1	1996 / 7 / 20	1995 / 2 / 14	
	INSPECTOR	YOSHIHIKO TAKISHITA	KENTA HITACHI	TARO KANDATSU	
	CENTER FREQUENCY (MHz)	11.2	10.5	15.3	
	LOWER FREQUENCY (MHz)	7.5	7.2	11.8	
	HIGHER FREQUENCY (MHz)	13.4	14.2	19.4	-----
	BAND WIDTH (%)	52.7	66.7	49.7	
	FOCAL DISTANCE (mm)	15.3	14.9	9.5	
	PULSE WIDTH (μm)	0.51	0.32	0.23	
	BEAM DIAMETER (mm)	0.18	0.19	0.16	
	SENSIVITY (dB)	-41.2	-36.2	-43.5	
	ELECTROSTATIC CAPACITY (pF)	210	202	193	
	⋮	⋮	⋮	⋮	
		ROW D	ROW E	ROW F	

FIG. 4

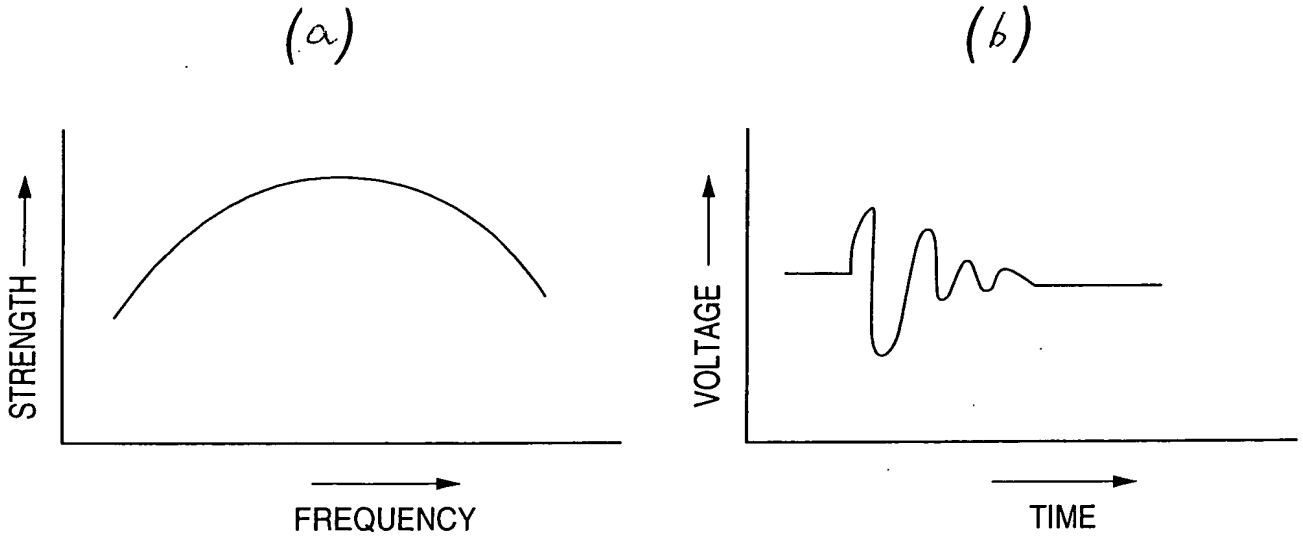

(a)
(b)
STRENGTH
FREQUENCY
VOLTAGE
TIME

FIG. 5

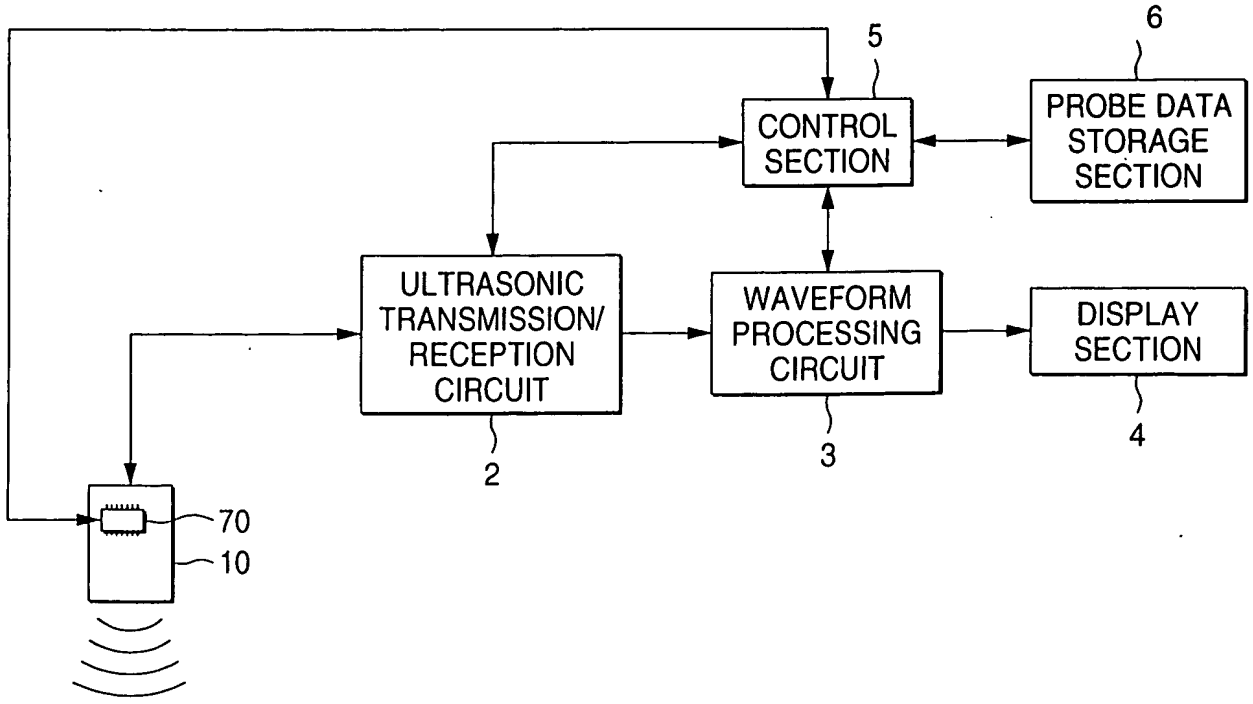

5
6
CONTROL SECTION
PROBE DATA STORAGE SECTION
ULTRASONIC TRANSMISSION/ RECEPTION CIRCUIT
WAVEFORM PROCESSING CIRCUIT
DISPLAY SECTION
2
3
4
70
10

FIG. 6

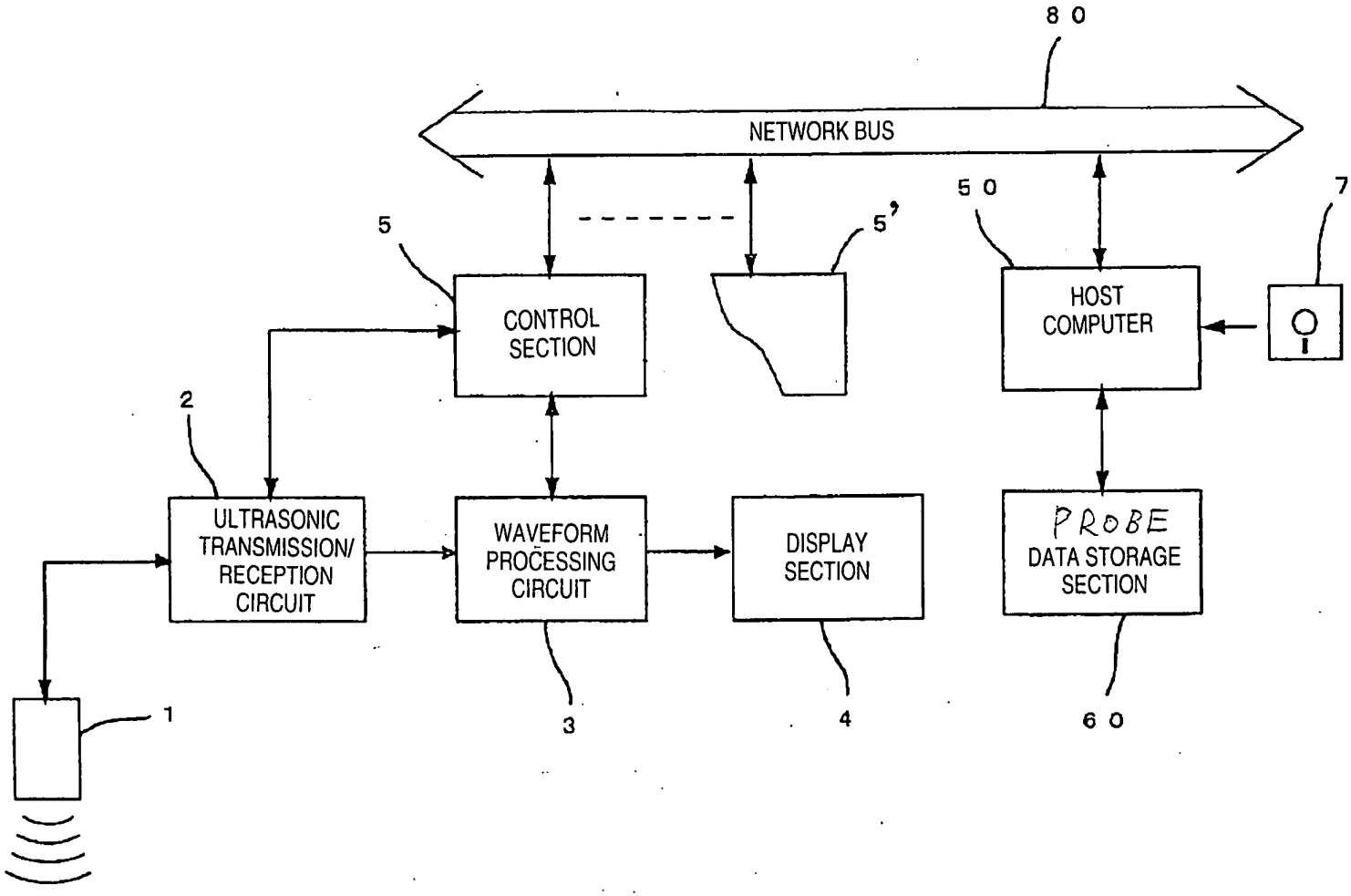
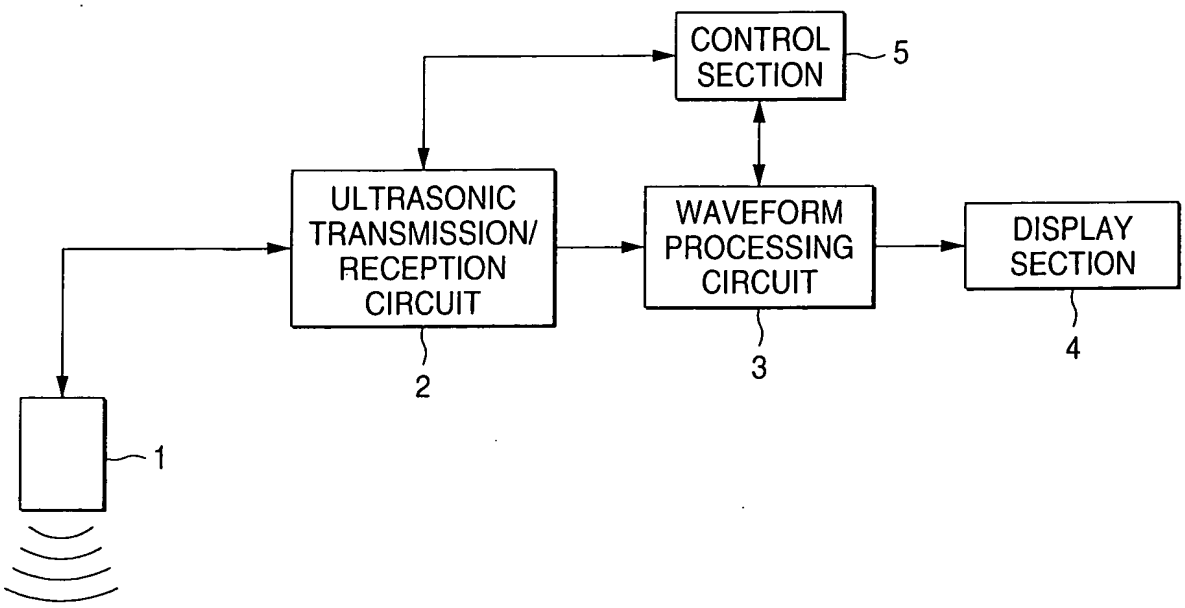

80
NETWORK BUS
50
7
5
5'
CONTROL SECTION
HOST COMPUTER
2
ULTRASONIC TRANSMISSION/ RECEPTION CIRCUIT
WAVEFORM PROCESSING CIRCUIT
DISPLAY SECTION
PROBE DATA STORAGE SECTION
1
3
4
60

FIG. 7


CONTROL SECTION
5
ULTRASONIC TRANSMISSION/ RECEPTION CIRCUIT
2
WAVEFORM PROCESSING CIRCUIT
3
DISPLAY SECTION
4
1